Chart List, dated 13 June '57. Authority of: Ms. [illegible] Cornett, A-SD.

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Mechanical Division of
GENERAL MILLS, INC.
114 Central Avenue
Minneapolis 14, Minn.

MINNEAPOLIS TEST REPORT

"Project Far Side"

By

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Contract No. NP 0507

Submitted to

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Report No. B-1033
Project: 59151
Date: 19 July 1957

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INTRODUCTION

This is a report on the Minneapolis test of "Project Far Side" under Contract NP 0507 with Aeronutronic Systems, Inc. This test was held on June 28, 1957 at General Mills Flight Center, Minneapolis, Minnesota. The purpose of this test was to provide information to be used in later operational flights. This report will be in lieu of the June Monthly Report.

FLIGHT OBJECTIVES

(1) Flight test the 212-1-1 balloon.

(2) Test the "Far Side" suspension system.

(3) Test the "Far Side" antenna and telemeter system.

(4) Secure a photographic record of the attitude of the rocket with respect to the balloon top.

(5) Secure a record of five strategic temperatures.

(6) Test the launch system.

RESULTS AND CONCLUSIONS

The flight proved beyond doubt the ruggedness of the balloon, the reliability and strength of all mechanical components, the practicability and feasibility of the balloon and load launching system, the alignment of the load and balloon system, and it also established a new record for balloon volume.

The 212-1-1 balloon received a much more severe test than anticipated. The ballast, which was released earlier than desired, allowed the balloon to reach a velocity of 1800 feet per minute. This resulted in super-pressurization and a definite valving bounce at an altitude of 105,000 feet.

The extra ballast was dropped when a relay locked contacts at 0958 CDT and would not open. The ability of the 212-1-1 balloon to withstand shock and carry heavy loads was undoubtedly proved. No recommendations were made for balloon design changes. The "Time vs. Altitude Curve" is shown in Figure 3.

The "Far Side" suspension system performed all of the tasks which could be tested with a dummy rocket. No member appeared to be overly stressed or weakened. The "kick-out" brackets could not be tested on this flight. Three recommendations for improvements are as follows:

(1) Design a cable holdback for the suspension arm in place of nylon.

(2) Lower instrument bag attachment point to the midpoint of the cage.

(3) Change the support method in the upper ring (nylon or styrofoam).

CAMERA

The balloon tilt with respect to the vertical and the rocket tip with respect to the balloon was less than anticipated. The tip of the rocket did not exceed 4 degrees even when the balloon was ascending at 1800 feet per minute and considerable turbulence was indicated. During the float period, tip and tilt were less than 1 degree.

The photographs indicate the tip was opposite the tilt, therefore, the rocket could be considered vertical and the top displaced as shown in Figure 10. Two photographs of the top fitting taken from the motion picture camera are shown in Figure 5 and Figure 6. Figure 5 was taken during the ascent and Figure 6 was taken during the float. During the float period the rocket was pointed at a position 6 to 12 inches from the apex of the balloon.

The rubber ball used as a plumb did not dampen out as rapidly as it should, therefore, the balloon tilt was measurable only late during the float period.

TEMPERATURE

The five strategic temperatures recorded on the dummy rocket housing ranged from 8.4°C. to 21.6° at 0815 CDT and approximately 12,000 feet. The same points recorded temperatures of -8°C to 18.1°C after float altitude was reached. Temperatures for the five points are tabulated for every fifteen minutes in Figure 1. Graphs of the five temperatures for the entire flight are shown in Figure 2. The portion of the rocket which was inside the plastic envelope did not exceed 26°C until after it was floating for an hour at ceiling (1100 CDT). The coldest point inside the plastic envelope was the bottom of Stage 3 which recorded 0°C during ascent. Stage 4, which was below the balloon, was colder during the entire flight. The coldest temperature recorded before 1100 CDT was -15°C.

The mass of the iron grit in Stage 1 and the yellow color of the zinc chromate combined to make the temperatures of this stage more stable until the ballast was dropped. As the angle of incidence of the sun became smaller and the ballast was dropped, the temperature of Stage 1 approached very closely the NACA standard ambient temperature.

The temperature of the skirt (T5) is conservative because it was in the shadow of the up-camera before it reached altitude. The graph shows temperatures changing very rapidly due to the sun rays as the rocket turned.

METHOD OF LAUNCH

The method of launch proved to be quite successful. The rocket was turned to the vertical position with no binding or hesitation. The trunnions were released although the balloon was not perfectly vertical. One side released first, however, this did not injure the cage or the rocket in any way. This would indicate considerable flexibility for the release.

The cage has been disassembled and packed for shipment to Aeronutronic Systems, Inc. The dummy rocket is in storage pending disposition from A.S.I. The package descended on three 28-foot parachutes with only superficial damage to a corn field on impact. Minor injury to a few parts was observed. Photographic coverage was obtained for all phases of assembly, launch, and recovery by photographers from A.S.I., Air Force and GMI.

FLIGHT SUMMARY

The flight, General Mills Serial No. 2232, was launched from the General Mills Flight Center near New Brighton, Minnesota, on 28 June 1957 at 0803 CDT. At launch, the wind was approximately 9 knots from the northwest and the surface temperature was 63°F. In the hour prior to launch, the wind reached a maximum of 14 knots as recorded on the Bendix-Friez recorder at the hangar adjacent to the launch site.

The inflation commenced at 0700 CDT and was terminated at 0755 CDT. The flight components totaled 3800 pounds and a free lift of 9.5 per cent (360 pounds) was added to produce an anticipated rate of rise of 710 feet per minute. The flight rose at 703 feet per minute to 81,000 feet, thereafter the balloon accelerated to an average velocity of 1800 feet per minute

because additional ballast was dropped. At 0938 CDT and 0956 CDT, the motion picture camera was operated, but no code was returned on the telemeter and as a result a check was made of the ballast control at 0958 CDT; the control was operated for approximately 15 seconds, but the relay remained closed. Ballasting continued until all was expended at approximately 1034 CDT. The balloon valved successfully without bursting at 1012 CDT although it was severely super-pressured. After valving under this condition, it descended until checked by the helium being warmed by adiabatic compression and the continuing flow of ballast. The balloon started a fairly normal descent glide of 80 feet per minute from 106,000 feet a few minutes after ballast flow ceased. One phase of the test not satisfied was the altitude-weight-volume relationship.

PROCEDURE

The 212-1-1 balloon used for the "Far Side" project was essentially being tested during the entire flight. In addition to the regular flight requirements, provisions were made to over-ballast and stress the balloon above its theoretical ceiling of 96,900 feet. The ballasting device consisted of five calibrated orifices which were electromagnetically controlled. The five valves were capable of dropping 53 pounds per minute. They were operated by radio control, timer, and anti-reversing aneroid.

The "Far Side" suspension system was tested by being subjected to forces which it will encounter in later flights. The dummy rocket which it carried was loaded to 1820 pounds and the center of gravity was located as indicated in Aeronutronic Systems, Inc. Drawing 100021. A pulse camera located in the nose of the rocket was designed to provide a photographic

record of the attitude in which the suspension system held the rocket during the flight. The vehicle was secured with safety lines to the suspension cage for descent purposes.

The "Far Side" antenna and telemeter system were the responsibility of A.S.I. They furnished their own instruments and engineers. GMI furnished a Sanborn recorder and a Tektronix scope.

The top of the rocket was fitted with two gun cameras which were sighted into a 90° prism. The rocket was bore-sighted on a target 200 feet from the cameras. A ground glass on the camera was used to align the cameras on the same target. One camera was coupled with a timer to produce a picture every 12 seconds. The other camera was radio controlled. The cameras were packed in styrofoam inside an aluminum hemisphere. The cameras gave a photographic record of the balloon top. From the balloon top, a 6-inch ball was suspended on a 28-foot cord to produce 6-inch displacement for each degree of tilt.

Five strategic temperatures were telemetered on a 40 megacycle transmitter. The audio signal and a signal generator were imposed on an oscilloscope for read-out of the frequency. Each white Bendix-Friez (No. 508603-2) rod thermistor was connected to the transmitter by a Brailsford sequence timer. The thermistor was attached to the surface with rubber gasket cement. Temperature sensing points were located on the parts as indicated in Figure 9. The rocket was painted with 4 to 6 mils of zinc chromate (MIL Specification P-6889).

The equipment for the launch included launching arm, inflation equipment, and launch vehicle. The launch arm was tested for strength and the feasibility of release with the existing gross load. The inflation

equipment required no special test except determination of the inflation time. The launch vehicle was tested for strength and performance for dynamic launching of loads greater than one ton. Motion pictures were taken of the aft end of the launcher during the arm release and truck release.

The rocket was loaded into the cage with a crane. Nylon straps were used around the rocket motors. The cage was slipped on from the nose end with support arms removed. After it had reached its position the arms were put in place and the rocket was lifted onto the support pins.

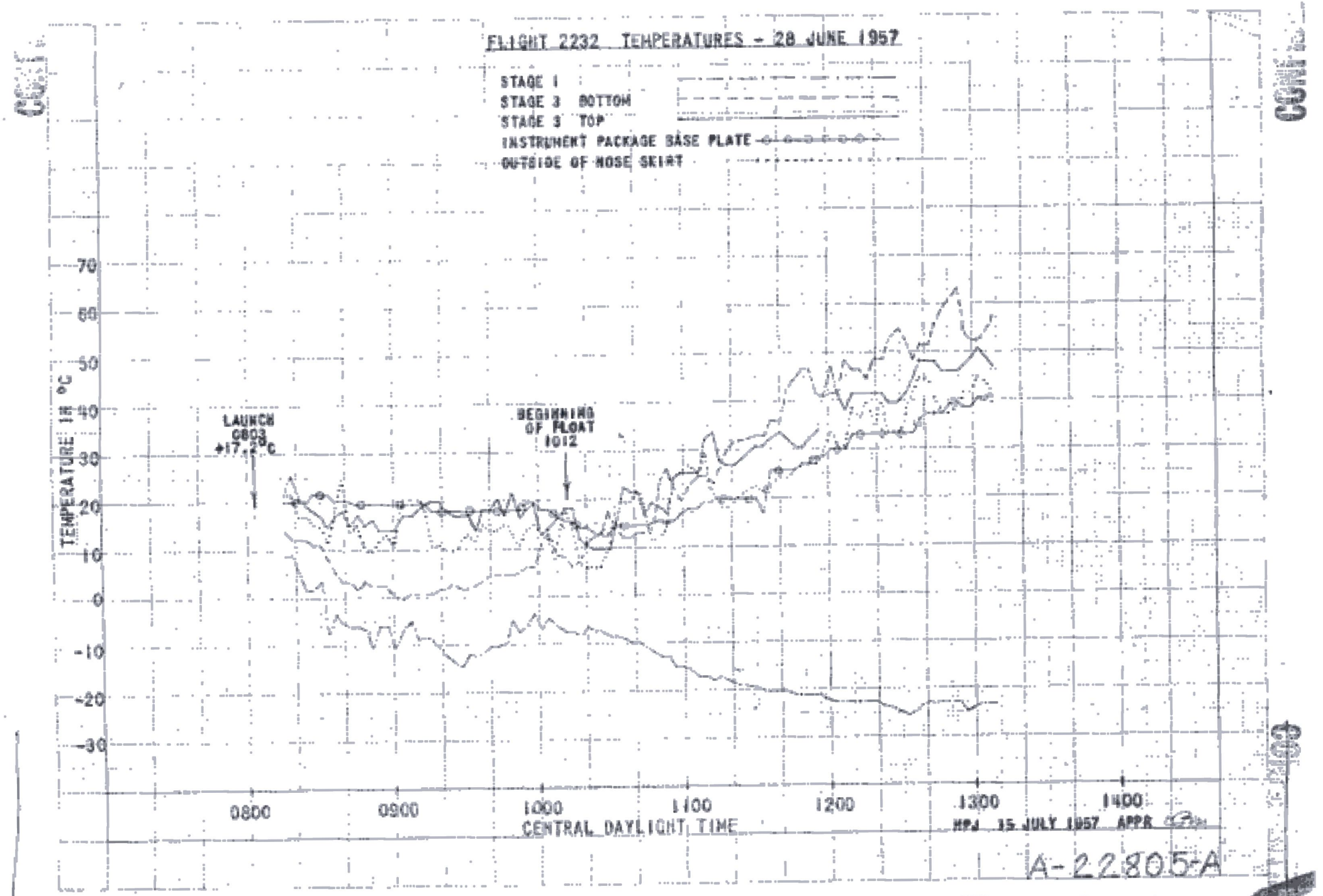
Recovery was accomplished with a minimum amount of delay. One truck and an airplane were used for tracking. The recovery vehicle was within 100 yards of impact site as the rocket and cage descended on three 28-foot parachutes. The cage was released from the balloon at 1312 CDT using 79 squib-operated tape cutters. Within thirty minutes of impact, all material was removed from the site. A minimum amount of attention was attracted.

TEMPERATURE DATA FROM MINNEAPOLIS TEST

Degrees Centigrade

Time	Altitude	Stage 1 T_1	Stage 3 Bottom T_2	Stage 3 Top T_3	Inst. Base T_4	Outside Nose T_5
0815	12174	9	14.	20.	21.5	21.5
0830	24758	3.4	11	21.6	15	17
0845	Tropopause 35572	-6	1.7	19.4	15	17
0900	44235	-10.5	0.7	19.4	10.8	14
0915	53717	-9	0.7	18	10.8	15
0930	62696	-12.2	1.7	18	13	17
0945	71660	-10	4.4	18	13	21.5
1000	83634	-6.7	11	18	10.8	13
1015*	103,720	-8	6.2	15.4	15	18.1
1030	106,342	-8.4	17.4	13.0	9.9	9.9
1045	105,777	-11	13	14.4	18.5	18
1100	104,950	-15.2	19.5	16.9	25.5	25.5

*Balloon reached float altitude.



RAMDON DEPARTMENT, MECHANICAL DIVISION, GENERAL MILLS, INC.: MINNEAPOLIS, MINN.

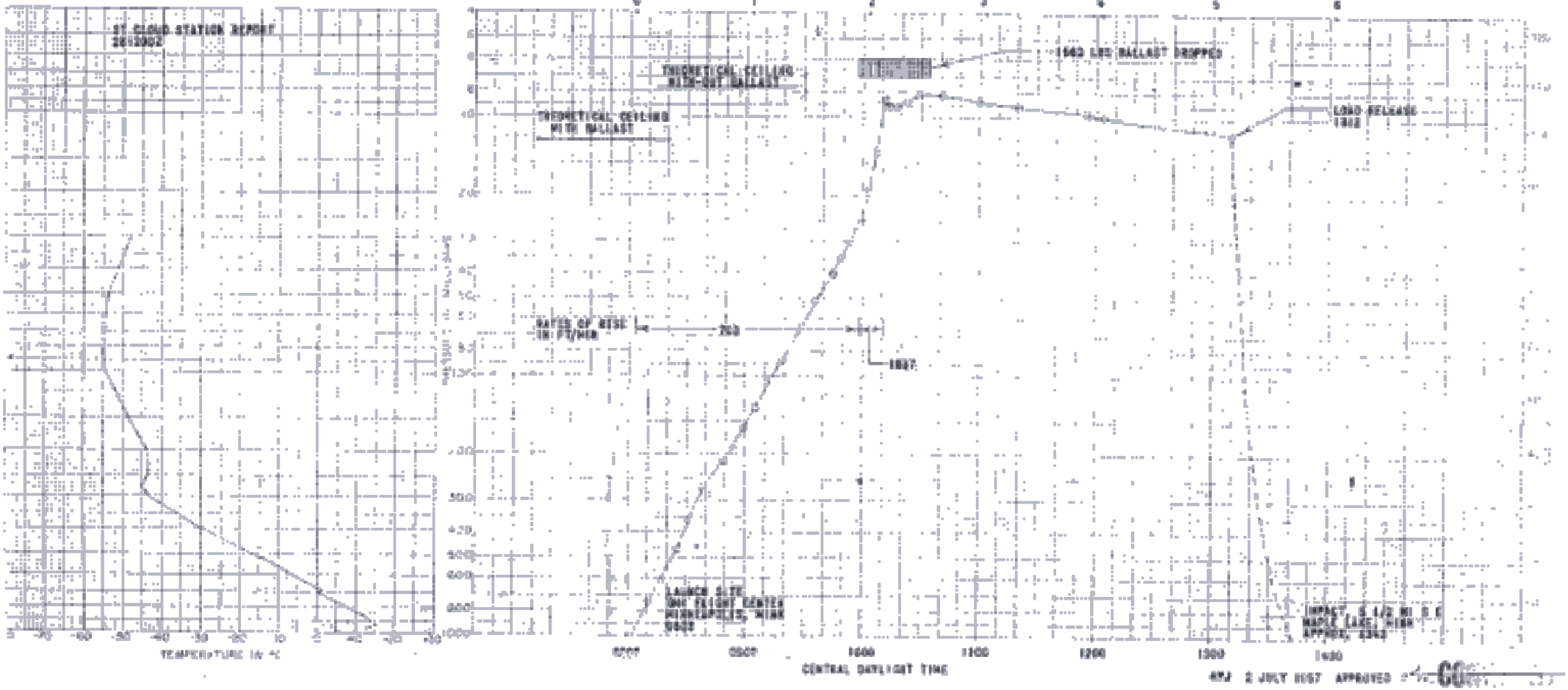
Figure 2

FLIGHT NO 2232 DATE 28 JUNE 1957
FOR 59151 "FARSIDE"
LOAD ON BALLOON 2306 LBS
FREE LIFT 369 LBS= 9.6%

BALLOON TYPE	NUMBER	MATERIAL	WEIGHT
212-1-1	BRS 107	2.0 MIL	1496 LBS

ALTITUDE DATA

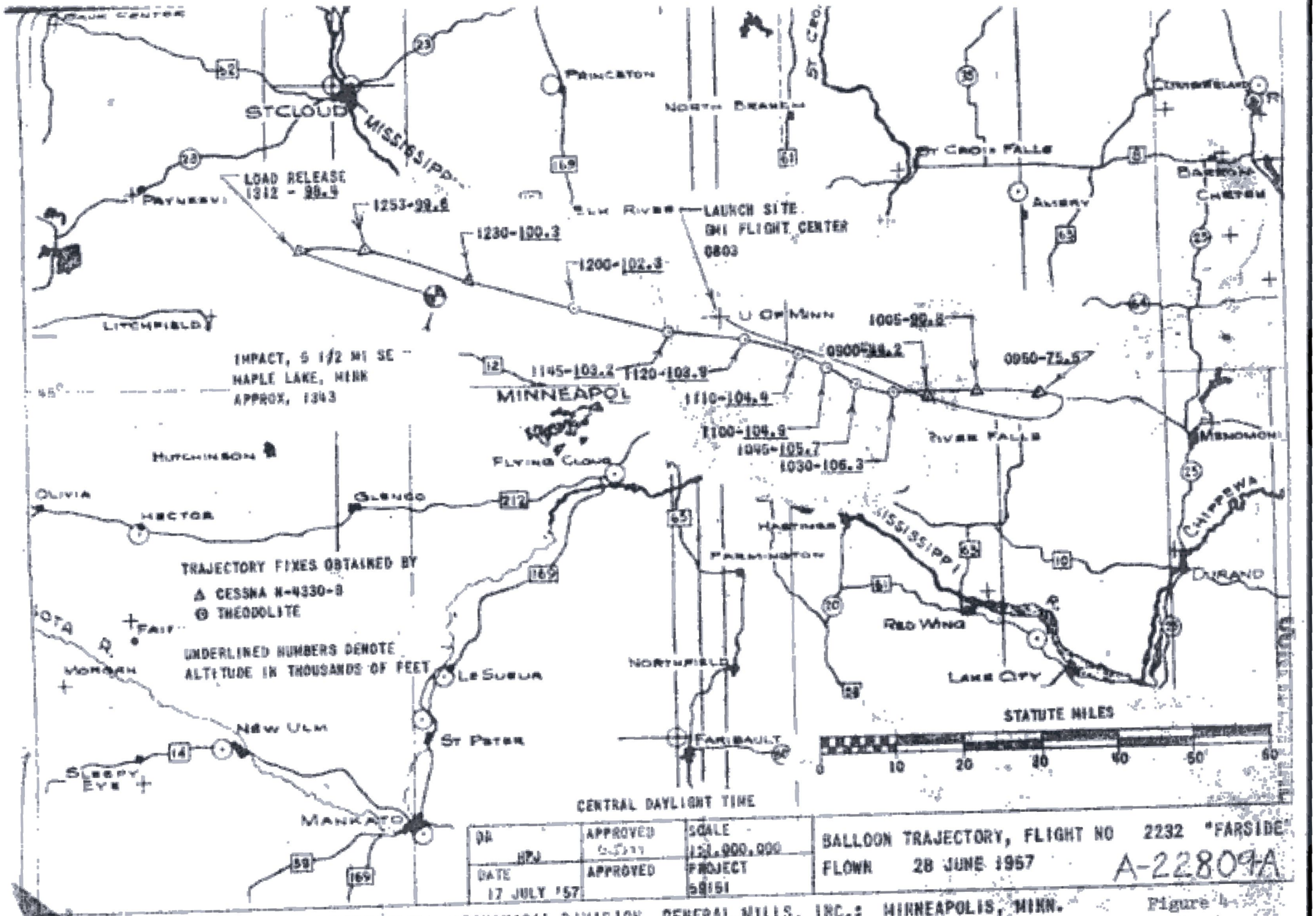
= CODESONDE



RJJ 2 JULY 1957 APPROVED

Figure 3

BALLOON DEPARTMENT, MECHANICAL DIVISION, GENERAL MILLS, INC.; MINNEAPOLIS, MINN.



DR HPJ	APPROVED	SCALE 1:1,000,000	BALLOON TRAJECTORY, FLIGHT NO 2232 "FARSIDE"
DATE 17 JULY '57	APPROVED	PROJECT 58151	FLOWN 28 JUNE 1957 A-22809A

BALLOON DEPARTMENT, MECHANICAL DIVISION, GENERAL MILLS, INC.; MINNEAPOLIS, MINN.

Figure 4

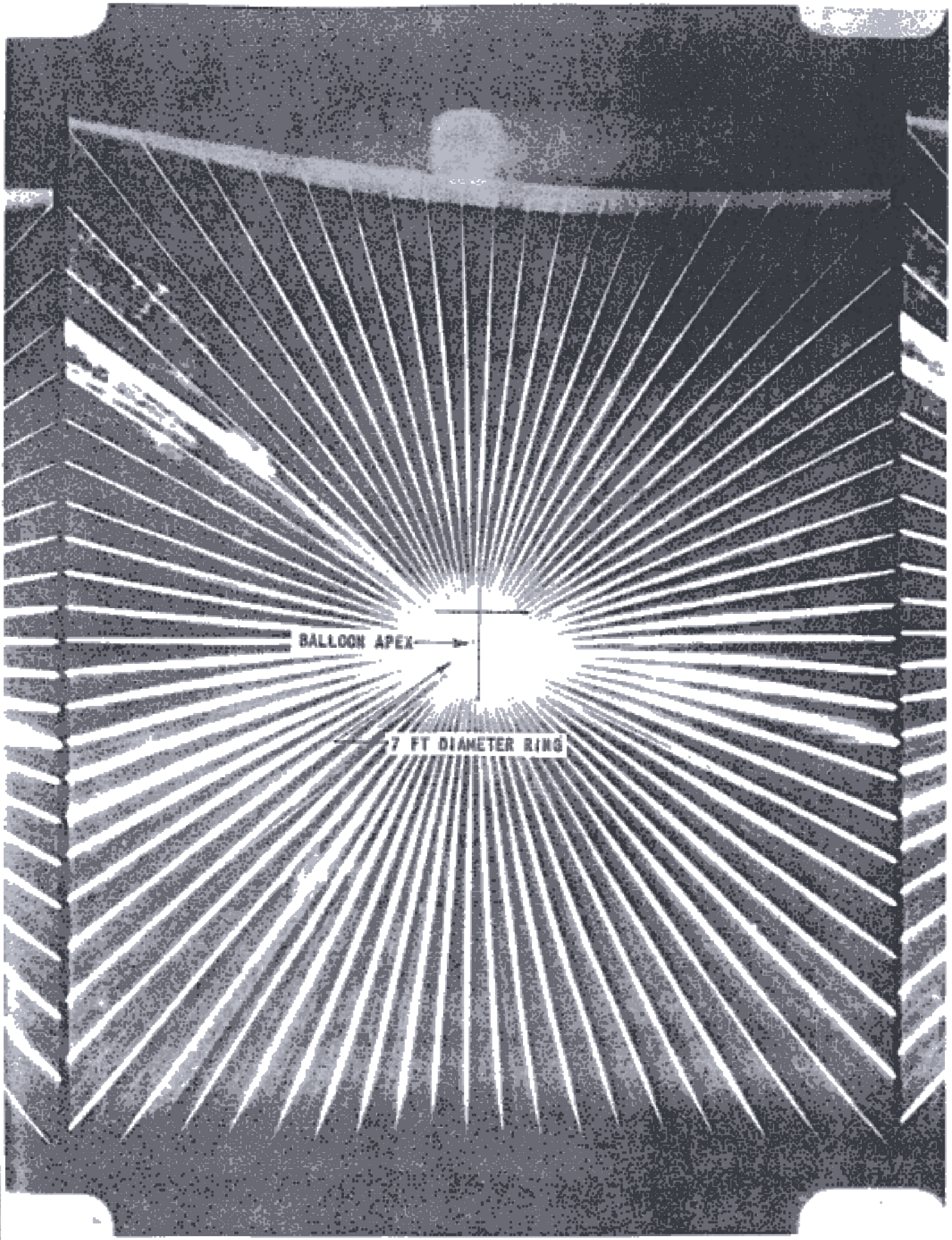
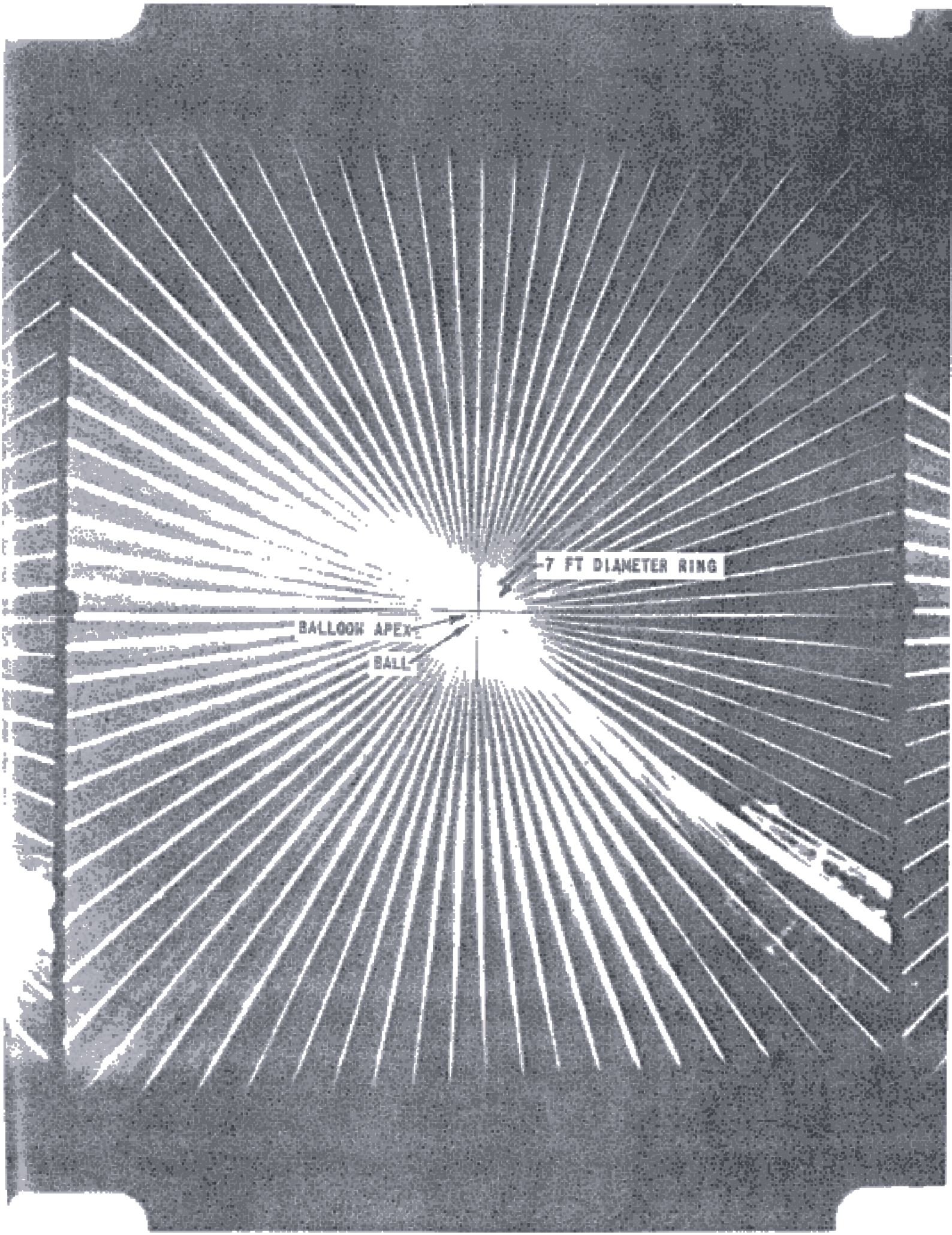


Figure 5


7 FT DIAMETER RING
BALLOON APEX
BALL

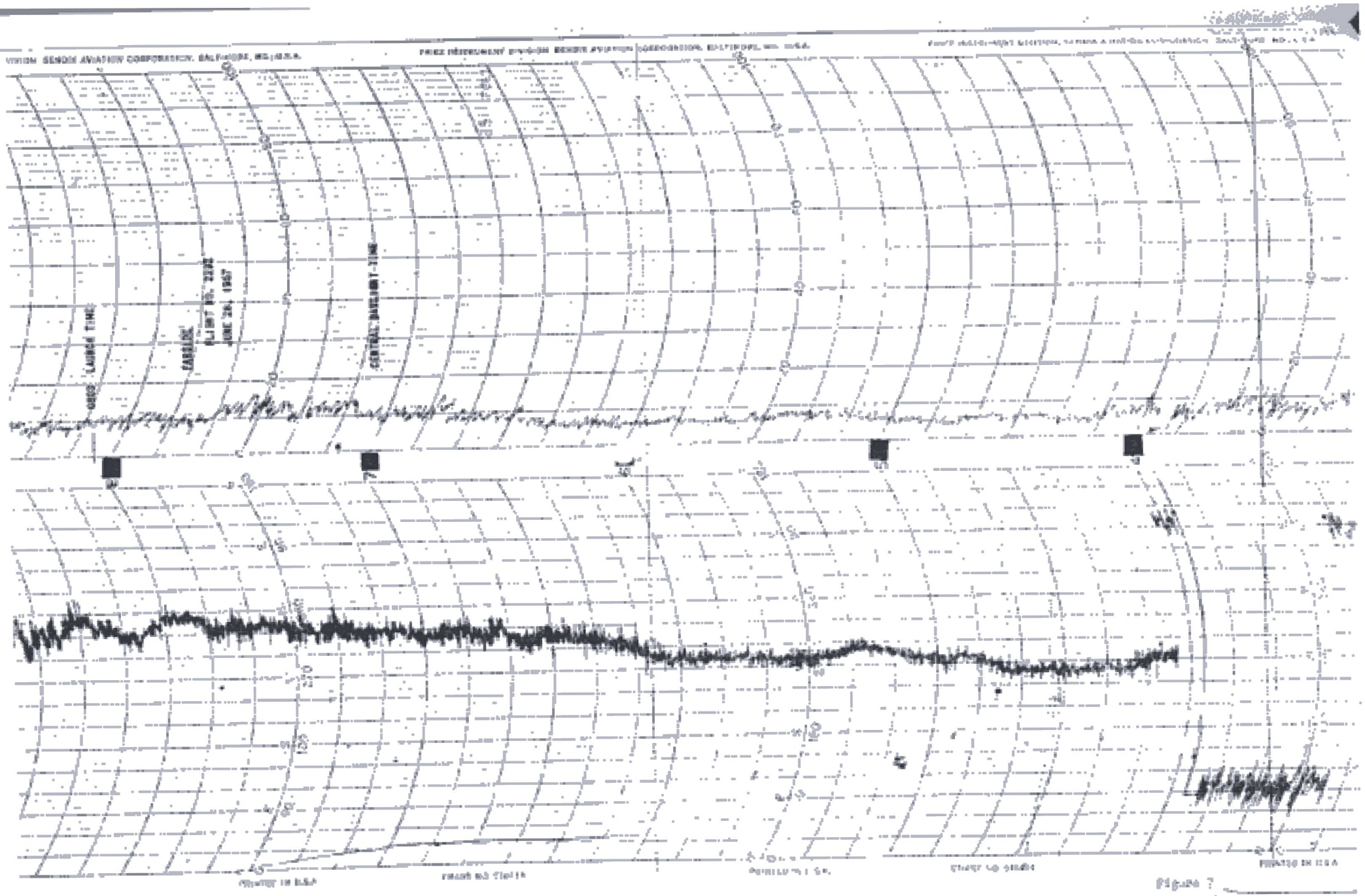

GMT
LAUNCH TIME
CARGO
FLIGHT NO. 2332
JUNE 24, 1967
CENTRAL DAYLIGHT TIME

Figure 7

SPECIFICATIONS FOR 212-1-1 BALLOON
$\epsilon = .15$ $S_\lambda = 303'$ INCLUDING ELONG.
THEORETICAL DIAMETER 211.55

Payload	2200 lbs.
Material	2 mil poly
Volume (estimated)	3,755,544 Ft.^{3}
Surface area (estimated)	124,305 Ft.^{2}
Inflated height	185.16 Ft.
Deflated length	303 Ft.
Number of gores	79
Load tapes	GMI 7-21 (650 lb. fortisan)
Half gore width of cylinder section; top	5"
Half gore width of cylinder section; bottom	5"
Fittings; top collar	230906
Fittings; bottom collar	230908
Number of ducts	2 - attached
Area size	30 Ft.^{2} each
Location of duct	45 Ft. from bottom apex
Inflation tube	20" layflat x 3 mil x 80' lg
Inflation attachment	230170 (25' from top apex)
Destruction device	None
Estimated balloon weight	1490 lbs.
Partial weights	

-430	B	was 200-1-1	6-11-57	DDW
-427	A	was 7-17 500 lb 212-N-1	6-7-57	DDW
-405		New Release	5-23-57	DDW

RWM	DDW
DDW	
ORIGINAL DATE OF DRAWING	6-7-57

Figure 8

230903

THERMISTOR PLACEMENT
ON DUMMY ROCKET

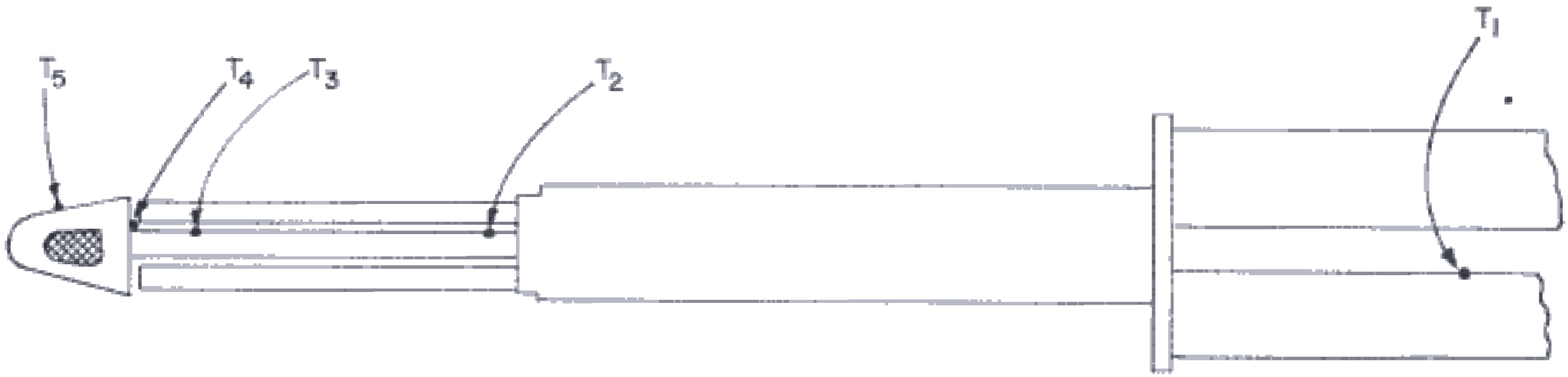


FIGURE 9

ROCKET ALIGNMENT

FIG. 10